

**Urban Agenda for the EU –
Digital Transition Partnership**

**External expert report on the
outcomes of Action 11 & 12**

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Summary

This report is an external expert evaluation of the outcomes of Urban Agenda for the EU – Digital Transition Partnership’s “Action 11: Support agile experimentation of emerging digital technologies” and “Action 12: Implementing the digital framework for emerging technologies within the digital infrastructure”. The report has been compiled based on the information gathered from interviews with the Action 11 & 12 leaders and publicly available sources.

Disclaimer

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1. Background and motivation

Successful digital transformation is in key role for European cities and municipalities to keep their essential services relevant and available to the public in a cost and resource efficient way. The key role of sustainable urban development and digitalization of public services in the transformation towards greener and more equal societies is highlighted also in many recent European agenda and policy documents [LeipzigCha, BerlinDec, LivingInEU], and the current COVID-19 pandemic has made the need for this change more evident than ever before. For smart cities, digital transformation is not enabled only by the various emerging technologies, but also by the new and innovative ways these technologies are combined and utilized in parallel with the existing city infrastructures. A large variety of stakeholders is required to work towards a common goal in the ecosystems supporting and driving this change, and often, pilot implementations and experimental evaluations are the only way to verify the feasibility of new use cases and digital service concepts in scale. Open innovation platforms and living labs are an essential tool for the ecosystems to collaborate on such pilots and experiments utilizing digital services and emerging technologies.

Today and in future, cities are the places where also first experimentations and deployments of new communication technologies take place. This has been the case, e.g., with the fifth generation telecommunication system (5G) technology experimentations carried out by industry and academy. The rollout of 5G for example has started and proceeds in cities across Europe by telecom operators and technology vendors. However, how to involve citizens and different business ecosystem actors to benefit from new technology has been the challenge. Enabling new information and communication technology, such as 5G, facilitation in open innovation platforms and open public places, will pave way also for further development of new technologies and services. For this, city facilitated innovation platforms and living labs are important, not only, from citizen and city services, but also technology developers and business point of view.

In addition to the many national digital agendas and 5G deployment roadmaps published by the EU member states, EURO CITIES as large collaboration network of European cities has also delivered a statement on 5G deployment, including the following requirements EU should ensure [EURO5G]:

- Balanced and fair 5G deployment – fostering equal distribution of 5G networks also in less densely populated areas, helping to reduce the digital divide and offering equal opportunities to all local ecosystem actors by safeguarding the EU network neutrality rules.
- Responsible and safe 5G deployment by coordinating and providing the information of impact of 5G on human health and environment with providing funding to support research on possible long term effects and implications.
- Sustainable 5G deployment in cities and common EU protocols on design of small cell devices to preserve visual identity of public spaces.
- Common and simplified regulatory framework on the use of public infrastructures to deploy 5G – telecom operators' liability rules to guarantee safety and security, and cost coverage for management of these public infrastructures.
- Clear governance rules about 5G data sharing platform, responsibility and liability of data management.
- Strengthened collaboration with city governments for deployment and implementation of 5G, including the development and testing of future fit policies and use and impact of new technology.

This statement is well aligned also with the need and development of open innovation platforms and experimentation facilities in EU.

The European Commission funded research on next generation mobile networks and future network technologies has been driven mainly by 5G Infrastructure Association (5G IA) and 5G Public Private Partnership (5G PPP). The different trials on 5G technology in variety of 5G PPP projects has been carried out still as private trials, however during the last years some of the trials has been extended also as public trials in cities [5GTrials19]. These pilots and technology trials, especially conducted in partnership with city authorities and public organizations, e.g., universities and research and technology organizations (RTOs), are paving the way for development of larger experimentation and innovation platforms.

In the 5G IA Trials Working group view, it is important for the development that the different involved stakeholders will come together to enable societal infrastructure benefits to the public, as new technology provided by 5G is seen as an opportunity to enhance and enrich the public services, increase the cities attractiveness and streamline the cities functions. It is also seen that there is a clear need to modernize city governance and processes in the framework of constrained public expenditure, and a related demand for deploying disruptive technologies enabling further digitization in public service delivery. For this, the open innovation platforms are essential tools [5GRoadmap].

The 5G is part of cities already now, and to conduct relevant trials is a way to ensure the development of the best feasible 5G solutions. The initial private trials, which were carried out by technology vendors and telecommunication operators, has laid the foundation also to city trials and pilot deployments, forming the basis of further commercial 5G deployment and use in city environment. In addition to private trials, the large scale publicly funded open test networks and trial environments, e.g., 5G Test Network (5GTN) [5GTN] in the city of Oulu, have been utilized as the first platforms to conduct also the city trials and public service pilots. These test network environments, funded by e.g. European Commission and EU member states, bring together both commercial technology vendors, operators and service providers as well as public authorities and academia, setting the initial ecosystem for further commercial deployment of 5G networks and services.

Within the 5G IA and 5G Trials Working Group, several smart city use cases have been reflected against the 5G functionalities. As example, the following Table 1 illustrates some of these technology requirements relevant for development of open innovation platforms for the smart city related use cases. The requirements are presented in the form of the required 5G services, i.e., ultra-reliable and low-latency communications (URLLC), massive machine type communications (mMTC) or enhanced mobile broadband (eMBB), and additional functionalities.

In addition to EUROCITIES and 5G PPP working groups, there are several other joint efforts on international, national and regional level defining the role of 5G and other new technologies in future urban environments and digital public services. Different groups are taking different approaches to the topic in their work, but all of them have the same long-term goal to enable more sustainable and equal living in the urban environments. At European level, Open & Agile Smart Cities [OASC] and Nordic Smart City Network [NSCN] are examples of networks of collaborating cities, whereas European Digital Innovation Hubs (EDIHs) [EDIH1] and European Network of Living Labs [ENOLL] are networks of open innovation platforms and living labs serving companies in their experimentation and piloting needs. The living-in.eu web-portal gathers the latest news and events from multiple European smart city collaboration initiatives on to single platform [LivingInEU].

Table 1. Use case requirements for 5G related to smart cities.

Use case	URLLC	mMTC	eMBB	Additional 5G functionality requirements
Automotive/ connected cars	x		x	V2X communications, edge processing, network slicing
Traffic management		x	x	Edge processing, network slicing, broadcast/multicast (feMBMS)
eAdministration / eGovernment, services for city administration			x	Private networks/operator networks, slicing support, data management/policies, security, trusted communications
eHealth	(x)	x	x	Enhanced network and data security / privacy, network slicing capabilities, reliability, performance (e.g., URLLC for remote surgery)
e-Learning / education			x	Broadcast / multicast support, slicing support
Energy	x	x	(x)	Network slicing, trusted and secured communications, enhanced reliability
Factories of Future / Industry 4.0	x	x	x	Private local networks, vertical-local access network (LAN), slicing, positioning, cybersecurity, time synchronization, edge processing, time-sensitive networking
Financial technologies (e-commerce)			x	Cybersecurity, trustworthiness
Media and entertainment			x	Load balancing for content, edge processing, feMBMS
Other public services for citizens (including culture, sports, services for public spaces etc.)	x	x	x	Support especially for IoT connectivity, efficient video and media communication, edge processing, network slicing, secure communications and privacy considerations
Public safety		x	x	Network slicing, edge processing
Public transportation / logistics		x	x	Network slicing, feMBMS, edge processing, local / private network operations
Smart buildings, construction / land use		x	x	Private local networks, network slicing, positioning, edge processing
Water management (incl. drinking water and sewage)		x		Long battery lifetime for sensors/energy efficiency, mobile broadband for video monitoring, edge processing

Even though 5G has been one of the most visible technologies deployed at the living labs and open innovation platforms during the past couple of years, the role of 5G in most smart city applications is to be only one of the key technology enablers. In addition to the connectivity, a variety of emerging technologies play a key role when new digital services are developed for urban environments and citizens. For example, artificial intelligence/machine learning, virtual/augmented reality, digital twins, blockchains and cybersecurity are all essential technological building blocks when data related to critical infrastructures and persons are

collected, processed, analysed and visualised for smart city applications. From the point of view of cities and municipalities, the key challenge is to find the best ways to include all of these emerging technologies into their digital infrastructure and make them available for the smart city service developers through open innovation platforms and ecosystems.

One successful example of the national collaboration in smart city domain has been Finnish 6Aika (Six City Strategy) joint strategy of the six largest cities in Finland; Helsinki, Espoo, Vantaa, Tampere, Turku, and Oulu [6Aika]. The 6Aika targets for city joint actions to tackle the common urbanization challenges. The Six City Strategy set up variety of projects especially for sustainable urban development, increase of employment, and competence development. The main target groups for the projects included especially the companies and research, development and innovation organizations as well as special target groups on e.g. unemployed youth, immigrants and jobseekers in general. The strategy included three large-scale spearhead projects:

- Open Data and Interfaces,
- Open Participation and Customership, and
- Open Innovation Platforms.

More than 60 development and innovations projects were started in different themes from e-learning, smart mobility, and health and well-being to circular economy and energy efficiency. The Six City Strategy enabled the project execution and companies' product development in real environment and with real users for example in schools, shopping centres, hospitals and different public spaces. These co-operation activities helped both companies to improve their products and city authorities to build and push forward the future smart city model, which enables new type of collaboration with cities, citizens and business through customer-centric co-creation and open innovation in real urban environment.

The Six City Strategy was implemented as a part for Finland's structural fund programme for sustainable growth and jobs 2014-2020 [SFS14-20]. Different development projects received funding e.g. from European Regional Development Fund (ERDF) and European Social Fund (ESF).

2. Overview of Action 11 & 12 outputs

Most of the activities under Action 11 & 12 have been carried out by the action leaders, i.e., city of Eindhoven, Netherlands, and city of Oulu, Finland. This section provides a short overview of the main outputs of Action 11 & 12 from Eindhoven and Oulu with references to more information for the interested readers. The city of Helsingborg, Sweden, and city Hamburg, Germany, have been in supporting role during the implementation of Action 11 & 12 and contributed to the work by sharing information and experiences related to their local living lab environments.

The living lab environments in both Eindhoven and Oulu have wide selection of innovation and experimentation services available to their local ecosystem as well as to external third parties. As ubiquitous wireless communication technologies are becoming more and more critical as an enabling platform for both the digital societies and industries, 5G testing environments have been the key living lab asset in both cities. A variety of other emerging technology platforms and pilots have been gathered around the 5G test facilities to provide specific focus areas for the living lab offerings based on the unique characteristics of the local ecosystems. These ecosystems are formed by the cities and public authorities as well as representatives from the local industry, service providers, RTOs and academia.

In Eindhoven, the 5G and IoT related living lab activities are focused around the 5G Hub [5GHub]. 5G Hub aims to familiarize potential users with the 5G technology, guide companies to apply it in their products and services, test new technologies on top of the test facility and build a technology community around these activities in order to facilitate information and idea sharing between the local parties utilizing the platform. It is also co-located and linked with other urban digitalization pilots in the area such as the High Tech Campus and Brainport Smart District. In these environments, new use case concepts and digital service pilots have been implemented already for healthcare and public safety with many more application areas to come. In addition to 5G Hub, dedicated testing facilities are going to be deployed in Eindhoven also for other emerging technologies, e.g., artificial intelligence and machine learning.

In Oulu, the key living lab test facility is 5GTN [5GTN], which have offered the next generation communication services to many of the smart city use case and digital service pilots in the area. The test network coverage focuses around the Linnanmaa district where the Oulu Technology Park and university Smart Campus are located. In addition to the main site, several remote test locations are offered for different kinds of experimentations. Examples of these remote test locations are OuluHealth Labs at the Oulu University Hospital, Port of Oulu and OuluZone motor sport centre, all of which provide unique experimentation possibilities for different kinds of service concepts utilizing also other new technologies such as artificial intelligence and virtual/augmented reality in realistic operational environments. The 5GTN infrastructure in Oulu is an integral part of the integrated communication and information technology research platform in the national 5G Test Network Finland (5GTNF) ecosystem spanning across eight Finnish cities. It also serves the experimentation needs of the Finnish 6G Flagship research programme. A more comprehensive list of available Smart City Oulu innovation platforms and pilot solutions can be found from [SCOulu].

In parallel with the deployment of living lab infrastructures and services, new funding and support mechanisms specifically tailored towards rapid development and ad hoc experimentation projects have been piloted in both Eindhoven and Oulu. In Eindhoven, dedicated funding and entrepreneurship mentoring have been offered to start-ups in order to facilitate the launch of new up-and-coming companies in the local ecosystem. Focused support for start-ups has also be seen as an opportunity to keep new talent and fresh graduates in Eindhoven. In Oulu, the key services offered to the start-ups, SMEs and individuals in the local ecosystem have been gathered under one roof and at BusinessAsema. The offered services include advice and training for setting up and developing new business, learning environments for small scale prototyping and sales practicing, and smart building test facility as part of the

local living lab environment. Through BusinessAsema, it is also easy to get in contact with the city, companies, RTOs and universities operating in the Oulu area.

3. Lessons learned during the implementation of Action 11 & 12

During the implementation of Action 11 & 12, a series of observations have been made regarding the partnerships, living lab technology platforms and funding for the pilots built on top of the available infrastructures. The following subsections summarize the lessons learned from these three aspects.

3.1 Building and organizing the partnerships

The preparation of large partnerships, such as the Digital Transition Partnership, is a challenging task due to the large number of topics and contributors involved in the process, but it also translates into real commitment to the execution of the activities when the partnership has been formed. As in the case of many publicly funded joint activities, the availability of the required resources from all key players can be difficult during the preparation as dedicated funding for the process is usually missing. In order to activate the contributors and guarantee successful result for the preparations, the partnership must be organized so that all involved partners are able to identify the benefits of the activities for themselves and for their local ecosystems. This requires skills and experience from the partnership coordinator so that the big picture stays clear and coherent throughout the preparation process.

Careful organization of the activities during a running partnership has also proven to be essential in order to keep the work progressing. The absence of dedicated funding for the participants' work within the partnership can lead to a situation, where the level of real cooperation between the partnership cities stays low even though on the high-level the interests are the same. In cases where the availability of resources limits the amount of work each participant can put into the partnership activities, the cooperation usually happens at the level of information sharing. Sharing of information on the experiences gained from local activities is a valuable form of collaboration, but it alone will not advance the aims to interconnect and integrate the offerings of the different European innovation platforms for urban technology experimentations and digital service pilots.

In order to facilitate active collaboration during partnership activities, the work related to living labs implementation and digital service pilots must contain added value for all involved contributors. In such cases, the activities will be most likely be performed in their full extent despite the possible resourcing challenges. In practice, when new partnerships are formed, it takes some time to develop trust between the collaborating actors and get to know the ways of work of the partners from different fields. Before the actors are familiar with each other, it is difficult to get the new collaborations working efficiently towards a common goal. An additional benefit of getting to know the new partners more deeply is the potential discovery of bilateral synergies and interests outside the topics covered by the partnership. Such bilateral interests can lead to additional cooperation, e.g., in the form of jointly funded EU projects, which strengthens and extends the scope and impact of the original partnership activities. An example of such a bilateral interest leading to a separate project during Action 11 and & 12 is the Flying Forward 2020 [FF2020] project developing a European Urban Air Mobility ecosystem.

When organizing new partnerships, a professional management and leadership team with commitment from region or city officials has turned out to be an invaluable asset for many living lab partners. A management team with correct mind-set for the living lab ecosystem work and real cooperation has been needed in order to keep the regional contributors active in the partnership actions as individual platforms participating to the regional ecosystems are still often competing with their individual offerings both nationally and internationally. When aiming for active EU-level collaboration and integration of infrastructures or digital services in different partnership locations, good cooperation and information sharing with participating countries' central government is an efficient way to maximize the dissemination and impact of the

achieved results. Dissemination through multiple channels at different levels of national and international collaboration forums also promotes further collaboration between national and international ecosystems inside EU and, potentially, makes the partnership aims and activities visible in the future pan-European agenda and roadmap documents.

3.2 Deploying and maintaining the living labs

Initial deployment of new technology platforms and testing facilities is expensive and slow as the key building blocks of such infrastructures are usually in pre-commercial state and, hence, do not yet have the mass-market status guaranteeing hardware and software component availability and economy of scale. This is evident especially in cases of large and complex infrastructures such as mobile communication networks. The role of the local ecosystem partners is highlighted in such situations as the involvement and commitment of major vendors and innovative smaller manufacturers of cutting-edge technologies is required to gain access to the new equipment. In cases where direct funding for the planning and deployment of the living lab infrastructure is missing, a different kind of incentive is needed for the industry partners to put in their time and effort. Usually, the win-win scenarios for infrastructure projects between the industry partners and public actors in the local ecosystem can be found from the correct mix of technological ambition and business potential in the targeted research topics and pilot use cases. When the industrial partners can see the added value of the local ecosystem activities for both their innovation and business processes, the required level of support for the infrastructure building can be attained.

In case of test facilities providing access to new technologies, there is always the challenge of continuous development also after the initial deployment. Implementations of new pre-standard or recently standardized technologies become old and obsolete very fast if the hardware and software are not maintained and updated regularly. Creating and following infrastructure development roadmaps can be challenging with limited partnership resources and usually requires considerable amount of support from the local ecosystems in the participating countries and cities. Instead of driving the building and maintenance of the living lab facilities, the role of the partnerships is better suited for the coordination of the activities between the partners and identification of new collaboration topics. When the living labs are comprised of generic building blocks provided to the partnership by the local ecosystems and technology platforms from different European countries, the natural role of the partnership is to bring these existing activities together and boost their visibility and reach to pan-European level.

One way to build larger interconnected living lab platforms relying on already existing test facility deployments and synchronize with pan-European efforts is to align the new local activities with the objectives of the EDIHs [EDIH2]. This approach can also open new possibilities for funding from the dedicated Digital Europe EDIH calls, especially for test facilities focusing on key emerging technologies, such as artificial intelligence, high performance computing and cybersecurity. An example of this kind of synchronization between national and international open innovation platforms is the Dutch Societal Innovation Hub approach where the local and regional ecosystems are collaborating in a coordinated way to offer joint services as an integrated Digital Innovation Hub. The Dutch approach combines technology testing and support services from test facilities focusing on 5G, artificial intelligence/machine learning, virtual/augmented reality, cybersecurity, etc.

When it comes to the targeted pilot use cases for the living labs, a fruitful approach combining the business potential for the industrial partners and benefit to the citizens for the public actors has been solving societal challenges with new technologies and service pilots on top of the living lab infrastructures. The alignment of the experiments with larger societal challenges makes it easier for the variety of local ecosystem partners (e.g., cities/municipalities, public authorities, technology providers and mobile network operators) to find common ground for joint activities. The outcomes of technology and service pilots with societal dimension are also

easier to communicate to the public and funding organizations when promoting the achieved results and justifying continuation activities, respectively.

However, even in the case of successful local pilots, generic scalability and feasibility assessment for the developed technology and services concepts must be carefully conducted before the solutions can be efficiently exported to other deployment locations. Not all verified technological concepts are generic enough for plug-and-play installations as the living lab infrastructures on top of which the concepts are deployed differ from city to city. Hidden differences, e.g., in the form of protocol interoperability or hardware and software version dependencies are examples of common roadblocks, which are identified only when installations to new locations have been started. Problems in the deployment phase can extinguish the early excitement towards joint service pilots and slow down the newly set up collaborations between living lab sites. Other examples of potential roadblocks when migrating pilots from one existing living lab to another is the careful selection of infrastructure hardware and software vendors required, e.g., in use cases related to public safety services. It can be that equipment from certain vendors with questionable reputation in data handling privacy and security must be ruled out from the networks handling sensitive or classified data.

3.3 Utilizing different funding sources

Commercialization of the living lab services would guarantee funding for the continuous maintenance and development of the infrastructure, but it has proven to be difficult to realize in practice. The initial investment when deploying the infrastructure as well as the costs related to the periodical upgrades and updates required to keep the technology platform relevant are so high that it is very challenging to self-fund all aspects of the living lab operations while assuming realistic utilization rates and reasonable pricing for the users. Consequently, the most feasible approaches to fund the living lab activities has been hybrid approaches combining large investments from the local ecosystem partners and public sources, such as the European Regional Development Fund (ERDF), to cover deployment and development of the infrastructure, and billing of the platform users to cover the running maintenance and operational costs related to the pilots.

In the context of the use case and service pilots build on top of the living labs, the limitations of the existing funding instruments have become evident. The activities related to the utilization of the living labs, especially by third parties not directly involved in the partnership or local test facility, are often tightly scheduled ad hoc experiments when new actors want to come and test the capabilities of the infrastructure. In these kinds of fast pilots, traditional funding sources for local joint projects, such as the ERDF, have proven to be too slow, inflexible and bureaucratic in their current form. This can prevent potential users of the living lab services from utilizing the infrastructure and its services. Examples of such potential users in the need for external funding for piloting are the local start-ups and SMEs operating with limited research and development (R&D) budgets. These are also a good example of potential users who would benefit the most from the services provided by the living lab sites.

Enabling local start-ups to innovate solutions to societal challenges with dedicated funding to piloting should be one priority for the living lab sites and local ecosystems. Support to the local start-up community is a good way to keep the new graduates and talents working as part of the local ecosystem and for the benefit of the region. Providing funding and mentoring support for the local start-ups to enhance their technology R&D processes and entrepreneurship skills as part of the services related to the living labs has great potential to multi-fold return of investment in the long run. The funding can be offered by local public authorities, universities or companies, and further boosted with innovation competitions and hackathons with prizes to winning teams or individuals. For individuals, traineeships at large corporations contributing to the local ecosystem provide an additional possibility for keeping the new talent in the area. This approach can be utilized, e.g., with students near their graduation.

4. Recommendations for the implementation of future partnerships

Based on the achieved results and lessons learned during the preparation and implementation of the Digital Transition Partnership and its living lab activities, the following recommendations are given for future projects with similar aims. The recommendations are given in the form of best practices identified during the preparation and implementation of Action 11 & 12.

As a general recommendation for the funding and organization of future partnerships, inclusion of some dedicated resources into the overall budget for the implementation of partnership actions would help to maximize the impact of the collaborations. This would alleviate the issues related to the scheduling and execution of joint activities between two or more living lab sites. These activities usually suffer the most from the resource shortage and can be delayed due to the long time it takes to find the suitable timeslots for the key persons to perform the work related to joint tasks. This does not only impact the technical work related to the implementation and deployment of technologies and services, but also the administration and dissemination activities supporting the technical work. The funding for the implementation of partnership actions could be realized in the form of co-funding to boost certain types of efforts at the local living lab sites. The benefit of a co-funding approach is not only the additional resources available to implement the action, but also the stronger commitment from the partners. Another option could be a conditional budget share, which becomes available if certain prerequisites for the partnership action are met. The conditions could be related, e.g., to the number of collaborating partners or external users utilizing the results of the joint activity.

Another general recommendation related to the additional funding possibilities for the living lab activities is to carefully align the partnership actions with the new European programmes for digital transformation and research and innovation (R&I), i.e., Digital Europe and Horizon Europe, respectively. Within the Digital Europe programme, the option could be the utilization of the dedicated EDIH calls for additional funding. In this approach, the effort needed to prepare the infrastructure and services of the local living labs for the EDIH calls must be taken into consideration when planning the partnership activities. In Horizon Europe calls, the living lab infrastructures could be utilized as test facilities for a variety of R&I projects and extended with new functionalities in the process. The strong focus on ecosystem building and societal challenges through R&I missions in Horizon Europe will make it easier for the partnerships to align themselves with the objectives of the jointly funded R&I projects.

1. Form professional administration teams to coordinate and drive forward the activities at the partnership and living lab level.

Instead of individual contact persons and coordinators responsible for the partnership related activities at different living lab sites, set up larger management teams with representatives from the partnership, local living lab ecosystem and city or municipality. The approach to include committed and like-minded persons from different stakeholder groups facilitates information sharing, keeps the ecosystem active and enables real cooperation in situations where the interests of an individual member of the management team would favour a single service provider approach. After all, the local test facilities participating to the living lab ecosystem can still be competing for the same customers as standalone platforms.

2. Ensure flow of information between the local, national and international ecosystems related to the partnership topics.

The partnerships offer a great opportunity to enhance the pan-European visibility of the local living lab ecosystems as part of a larger network of collaborating innovation platforms. In addition to the enhanced local cooperation facilitated by the living lab administration teams and ecosystems, direct communication links towards central government officials participating to different EU policy and working groups related to the partnership topics are an invaluable asset while disseminating and collecting information. Efficient information exchange at multiple levels

in the local and global networks can aid to maximize the impact of the running partnership activities and create new collaboration opportunities in the future.

3. Utilize the entire partnership network for information sharing and seek smaller groups of partners for the practical work related to joint experiments.

While a partnership is running, it is important to utilize it efficiently for multiple purposes. For the local living labs participating into the partnership, it is beneficial to first identify a smaller group of partners with similar interests and aims for continuous discussion around detailed technical topics and exchange of experiences during implementation of pilots. The continuous discussions keep the cooperation active and help to identify common problems suitable for further collaboration also outside the running partnership. In addition to the more intensive cooperation within a smaller group of partners, it is important to be active also at the whole partnership level in actions, which are not in the direct focus of the current pilots at the local living lab, but which have potential in the local ecosystem for future spearhead topics.

4. Combine and packetize the services offered by the local living labs and promote it as a joint pan-European service at the partnership level.

Real cooperation between living lab sites residing in different countries can be built around combined and integrated service offering targeted towards potential customers in a selected technology or vertical industry domain. With the support of the partnership, the third parties interested in deploying pilots on top of the existing living lab infrastructures can be served with international test facility assets if the local ecosystem cannot fulfil their needs. Smaller players interested in pilots usually do not have the resources to set up pilots in other countries without the contacts available through the partnership. Pilots in other countries can usually be operated either on location or remotely if the required support from the living labs is available.

5. Ensure that all the relevant stakeholders from the entire value chain related to the targeted use case are represented in the local ecosystem when preparing the living lab for service pilots.

When selecting target use cases and service pilots for the local living lab participating to a partnership, make sure that all relevant stakeholders from the local ecosystem are committed to contribute also to the partnership activities. For example, in case of service pilots related to smart buildings or districts, involvement of the technology vendor, mobile network operator, property developer and city is needed to guarantee the required access to new equipment, existing communication infrastructure, buildings and public areas. Inclusion of all relevant actors prevents implementation roadblocks caused by unavailable resources or permits for the planned deployments. In order to increase the commitment, it is important to focus the use cases and pilots so that they have innovation and/or business potential for all involved partners.

6. Form the use cases and pilots around societal challenges to make them more approachable for the local ecosystem partners.

In order to include as many local ecosystem partners as possible, form use cases and pilots targeted in the partnership around societal challenges and megatrends. It is easier to find common interests for the local ecosystem when the problems to be solved are generic in nature and in line with the high-level national and international agendas, which are in their part guiding the R&D and business strategies of companies with international customers. From the point of view the visibility of the partnership results, piloting activities focusing on societal challenges are also easier to communicate towards the public.

7. Define the role of the partnership to be the coordinator of the generic technological building blocks and service offerings coming from the local living lab ecosystems.

Utilize the partnership for the coordination of contributions from the local ecosystem to the living lab infrastructure. By taking into consideration the needs of the partnership's combined

pan-European service offering, the individual technology components and piloting capabilities offered by the local test facilities can be linked to the other living labs more easily. Seeing the big picture when planning development roadmaps for the local infrastructure facilitates active cooperation during and exploitation of the results after the partnership.

8. Ensure that each service pilot planned to be migrated between living lab sites is thoroughly analysed before committing resources to the technical work.

If existing service pilot implementations are planned to be exported or migrated from one living lab site to another as part of the partnership activities, adequate resources should be reserved for the analysis of technical compatibility of the utilized technology platforms. If the service migration fails due to unexpected inter-operability issues caused by differences in the infrastructure implementations and configurations, and the all cooperation activities are planned to be related to this specific service pilot, the whole partnership action can fail.

9. Prepare both funding and development roadmaps for the local living labs to make sure that the survival of the local infrastructures is not dependent only on the partnership activities.

For the local living lab infrastructures participating to the partnership activities, it is crucial to prepare a funding and development roadmap covering the entire duration of the partnership. As dedicated funding for infrastructure investments and maintenance is usually not available directly from the partnership, a plan for multi-annual partner investments or jointly funded project portfolio supporting the technology platform is needed. The plan can be used to guarantee that an up-to-date living lab is available at least in some form for the partnership activities throughout its lifetime.

10. Arrange flexible ad hoc funding possibilities towards the utilization of the living lab services for start-ups and SMEs operating in the local ecosystems.

For the specific needs of local start-ups and SMEs, extra support to utilize the services offered by the living labs is needed in the form of flexible funding opportunities. Traditional regional funding instruments usually fall short either in their flexibility to cover multiple kinds of expenses or in the time and effort needed to apply the funding. The possibility to locally link lightweight public funding instruments to ad hoc piloting needs on top of the living lab sites as well as other complementing funding sources, e.g., in the form of prizes related to innovation competitions and hackathons sponsored by local companies, should be investigated and set up already in the preparation phase of the partnerships.

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